Author reply to Review by Anonymous reviewer:

We thank the reviewer for his/her valuable comments which improve the clarity and the exactitude of the manuscript.

Referee comments are repeated in black font, author replies are given in red font.

Overview

In this study the authors report very interesting ground‐based measurements of aerosol hygroscopicity and black carbon (BC) properties during wintertime in Paris. BC properties are analyzed as a function of aerosol source and air mass type. The authors find that BC originating from traffic was non‐hygroscopic and does not show a coating while biomass burning aerosol is slightly more hygroscopic with a medium coating thickness and a larger mean BC‐core diameter. The largest coating thickness and largest growth‐factors are reported for aerosol originating from Eastern Continental Europe.

In this study an interesting data set of quality‐controlled aerosol measurements is presented. The structure of the manuscript is reasoned and the paper is well‐written. However, the manuscript is full of acronyms of instruments and campaigns that can hardly be avoided. I would recommend to avoid too many acronyms in a publication if the reader might be overwhelmed by so much capitalised material. For example, I did not remember at this point what a COA is.

As mentioned, it is hard not to use campaign and instrument acronyms. We tried to only define acronym reused later in the text.

I recommend this manuscript for publication in ACP after the following minor comments have been addressed:

Specific comments:

Use of the term "biomass burning" in this study: Please define how the term "biomass burning" is used in this study. Do the authors refer to emissions from the burning of living dead vegetation (boreal/tropical forests, savannas, agricultural land) or do they rather refer to the emissions from residential heating or something else?

The term biomass burning used here refer to both the burning of living dead vegetation and residential heating since the PMF analysis applied to the HR-ToF-AMS data did not allow the discrimination of 2 separate BBOA factors in this case.

p. 25122, l. 17: Coating thickness of ~ 2nm: How meaningful is this number given the uncertainty of ±10 nm reported in section 2.3.1.

This has been changed to: "2 ± 10 nm" in the abstract and main text. The uncertainty of the coating thickness has also been added in the footnote of Table 1.

p. 25122, l. 23: Please define D0.

Done

p. 25123, l. 1 : What is a boxdetectable BC core? Please clarify.

It was a typo. It has been changed to "detectable".

p. 25124, l. 4: "primary organic matter (POM)". Has already been defined on page 25123

It has been removed.

p. 25124, l. 3: "In Paris, the smaller EC‐containing particles (Dva ≤ 400 nm) were mainly externally mixed, indicating local or regional sources, while bigger EC‐containing particles Dva ≥ 400 nm) were mainly internally mixed with nitrate compounds, indicating medium to long range transport." Results should not be presented in the introduction.

We believe that it is justified to summarise the conclusions from previous publications in the introduction in order to identify the gaps that the current study addresses.

p. 25128, l. 5: remove “and“
Done

p. 25129, l.4: bias or uncertainty?
The refractive index chosen for the interpretation of measured scattering cross sections is the main sources of uncertainty for the resulting optical diameter of purely scattering particles. Choosing a too high or low refractive index leads to systematically biased optical sizes (underestimated or overestimated, respectively). It has been changed to “uncertainty” in the manuscript.

p. 25129, l.12: “(…) long wavelength (…)”add: compared to the size of the BC particles
Done

p. 25129, l.21: “(…) while single particle data can have even more negative values due to random noise (as seen in Fig. 10). Please give a little bit more detail, since this might not be clear to non SP2 users.
The major source of random noise in the coating thickness values determined for single particles with the approach introduced by Gao et al. (2007) is the variability of the velocity of individual particles as they cross the laser beam. Random noise of for example the BC mass measurement as well as for example the potential variability of the refractive index of the BC cores of individual particles also give minor contributions to the random noise in the coating thickness values. As a result, the uncertainty of coating thickness values of individual particles is larger than the ±10 nm reported for systematic uncertainty of the average of coating thickness values of many particles.

We did not add the technical details about the sources of random noise. Nevertheless, we reworded this paragraph:
“The resulting systematic uncertainty of coating thickness values of uncoated BC-containing particles with a mass equivalent diameter of 200nm is estimated to be ±10nm at Δ_{coat} = 0nm. Negative coating thickness values within this tolerance are thus not a concern. It is important to note that this uncertainty refers to the average over many particles, as the coating thickness value determined for an individual particle is associated with additional random noise. Further discussion on the uncertainties associated with the coating thickness is available elsewhere (Schwarz et al., 2008b; Laborde et al., 2012b).”

Schwarz et al. (2008): Measurement of the mixing state, mass, and optical size of individual black carbon particles in urban and biomass burning emissions, Geophys. Res. Lett., 35, L13810, doi:10.1029/2008GL033968

Laborde, et al. (2012) Single Particle Soot Photometer intercomparison at the AIDA chamber, Atmos. Meas. Tech., 5, 3077-3097, 2012, doi:10.5194/amt-5-3077-2012.

p. 25129, l.23: with above assumptions. add “the” between “with” and “above”
Done

p. 25129, l. 18: “Briefly, sizing differences between the first and second DMA are corrected for with dry measurements of ambient air.(…)” please give more detail
A full description of the data inversion and correction is available elsewhere:
Gysel et al. (2009). We believe that going into more details about the well-established data correction of the HTDMA would dilute the message of the manuscript.

Gysel, M., McFiggans, G. B., and Coe, H.: Inversion of tandem differential mobility analyser (TDMA) measurements, J. Aerosol. Sci., 40, 134–151, 2009. 25130

p. 25129, l. 22: TDMAinv HTDMAinv??
TDMAinv. This algorithm is suitable for any TDMA systems.

p. 25131, l.22: “C = 4.2 (…)f =1.3” define “C” and “f” and give more detail.
We also believe that a full explanation of the aethalometer correction if available somewhere else and that giving more information about it will disturb the reader and dilute the message of the manuscript. The reference to Weingartner, 2003 is given in the current manuscript for the reader to find more information if necessary.

p. 25147, l.11: “brush fire” bush fire?
It is mentioned as brush fire in the publication.